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BEFORE THE PUBLIC UTILITIES COMMISSION OF THE STATE OF CALIFORNIA

Order Instituting Rulemaking Regarding Policies, Procedures and Rules for Development of Distribution Resources Plans Pursuant to Public Utilities Code Section 769.	Rulemaking 14-08-013 (Filed August 14, 2014)
And Related Matters.	Application 15-07-002 Application 15-07-003 Application 15-07-006

(NOT CONSOLIDATED)

In the Matter of the Application of PacifiCorp (U 901-E) Setting Forth its Distribution Resource Plan Pursuant to Public Utilities Code Section 769.	Application 15-07-005 (Filed July 1, 2015)
And Related Matters.	Application 15-07-007 Application 15-07-008

JOINT REPLY COMMENTS OF SOUTHERN CALIFORNIA EDISON COMPANY (U 338-E), SAN DIEGO GAS & ELECTRIC COMPANY (U 902-E), AND PACIFIC GAS AND ELECTRIC COMPANY (U 39-E) ON THE ADMINISTRATIVE LAW JUDGE'S RULING REQUESTING COMMENTS ON REFINEMENTS TO THE INTEGRATION CAPACITY ANALYSIS

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Dated: **September 30, 2019**

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I.

INTRODUCTION

Pursuant to the July 3, 2019 *Administrative Law Judge's Ruling Requesting Comments on Refinements to the Integration Capacity Analysis* ("ALJ Ruling"), Southern California Edison Company ("SCE"), on behalf of itself, Pacific Gas and Electric Company ("PG&E") and San Diego Gas & Electric Company ("SDG&E") (collectively, the "Joint IOUs") respectfully submit these reply comments.[1]

In these reply comments, the Joint IOUs address the following issues:

- The interconnection use case is the most immediate application of Integration Capacity Analysis ("ICA") and the planning and policy use cases, including load ICA, should be prioritized accordingly.
- Summarize each IOU's data validation plan.
- Respond to stakeholders' comments regarding the ICA user interface.

II.

DISCUSSION

As discussed in opening comments,[2] during the September 9, 2019 workshop on long-term refinements to ICA, and throughout the Rule 21 Working Group,[3] the interconnection use case is the most immediate and most tangible application of Integration Capacity Analysis (ICA). The stakeholder

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1 Pursuant to Rule 1.8(d), counsel for Pacific Gas and Electric Company and San Diego Gas & Electric Company have authorized counsel for SCE to file and serve these joint reply comments on their behalf.

2 *See, e.g.*, *Comments of the Interstate Renewable Energy Council, Inc. on Refinements to the Integration Capacity Analysis* ("IREC Comments"), filed Aug. 1, 2019, at pp. 12-13; *Comments of the Public Advocates Office on Administrative Law Judge's Ruling Requesting Comments on Refinements to the Integration Capacity Analysis* ("Cal Advocates Comments"), filed Aug. 1, 2019, at p. 1; *Comments of the California Solar & Storage Association on Refinements to the Integration Capacity Analysis*("CALSSA Comments"), filed Aug. 1, 2019, at p. 6.

3 R.17-07-007, Working Group Two Final Report, filed Oct. 31, 2018, at pp. 38-89.

and Energy Division discussion during the September 9 workshop indicated agreement that the interconnection use case should be prioritized given its immediacy with the proposed changes to Rule 21. Therefore, the Joint IOUs recommend prioritizing the interconnection use case to ensure the accuracy of the generation ICA results over further development of the policy and planning use cases. The Joint IOUs appreciate the need for accurate and relevant load ICA results as well. However, given that the interconnection use case has no bearing on the load ICA results, the Joint IOUs recommend that the load ICA be prioritized appropriately.

A. Data Validation Plans

The process of calculating and displaying ICA data is intensive, requiring the development and implementation of a well-tested and thought out data validation process. Each IOU's ICA data is derived from hundreds of millions of data points that must correlate with the correct circuit models and data inputs. The data is subject to errors that must go through a QA/QC (i.e., quality assurance) plan to avoid, identify, and mitigate errors and ensure ICA results are valid. Each IOU has a QA/QC process to flag inconsistencies identified at various stages throughout the ICA process as shown in the appendices. This enables each IOU to have a level of certainty on the accuracy of the models used to run the ICA. This QA/QC process will be an ongoing process that will continue to be defined and developed by each IOU.

B. Load ICA Methodology, Assumptions, Process

One of the themes seen in the other parties' opening comments,[4] and discussed at the September 9, 2019 workshop, relates to load ICA and the concern that many line sections across all IOUs have a published load ICA value of zero. The Joint IOUs acknowledge that having over 50% of nodes showing zero load ICA will need further investigation and refinement. When the ICA methodology was originally defined, the focus was on the interconnection use case and very little time was spent on load

[4] *See, e.g.*, IREC Comments, at p. 4; CALSSA Comments, at p. 2.

ICA. This is further demonstrated by the fact that a use case for load ICA does not exist today, while an interconnection use case that leverages the generation ICA results is expected within Rule 21. The Joint IOUs consider the interconnection use case a higher priority and do not view the development of a load ICA use case to be of high priority. If a load ICA use case and application is determined, the Joint IOUs would then work to implement any required modifications to the load ICA to enable the agreed upon use case. If the Commission determines that a load ICA use case is required, the Joint IOUs recommend a series of working group meetings to align on the use case, methodology, and assumptions.

Given that ICA as implemented today is first-of-its-kind, the results produced may be unexpected to some stakeholders. For example, some stakeholders expect the load ICA results to more closely match the Grid Needs Assessment ("GNA"). However, if a line section is listed as having a load ICA of zero, it does not necessarily mean the same line section would be reported in the GNA. Reasons for this difference include, but are not limited to:

- The inputs are different – ICA is based on historical loading, while the GNA describes the needs that result from the forecast.
- The hours studied are different – ICA evaluates the system under 576 different hours that represent the annual load profile. GNA evaluates the system under forecasted peaks.
- The study processes are different - ICA is an automated 576-hour analysis. The GNA is an analysis performed by an engineer using planning tools. The analysis within the GNA allows for more circuit-specific assessments to be performed.

For these reasons, a direct comparison between ICA and GNA is not relevant.

Regarding the low load ICA values at PG&E:[5] PG&E's 2019 data validation efforts have resulted in a decrease in the number of line sections with a load ICA value of zero. PG&E is comfortable with the load ICA results produced going forward and their use for informational purposes only. However, there are a few important caveats to consider. As implemented today, the load ICA does not include: 1) A load forecast, 2) a queue of known, new load projects, 3) planned switching, and

[5] SCE and SDG&E do not join in the response by PG&E in this paragraph.

4) planned distribution system upgrades. Load ICA does provide a high-level idea of available capacity, but PG&E encourages customers to always check with PG&E first.

C. User Interface

The Joint IOUs together have discussed various aspects of the ICA user interface and provide below responses to various items discussed with stakeholders at the September 9, 2019 workshop.

1. Single-phase/Three-phase Interface (Joint IOU)

Should the Commission deem inclusion of additional functionality beyond what has previously been directed and is currently available, the Commission should provide that directive by a full Commission decision.

During the September 9 workshop, stakeholders discussed functionality in which users of the IOUs' external portals would be able to understand the locations where single-phase line segments connect to three-phase nodes. As discussed, each IOU's external portal currently provides the data needed to allow a user to trace single-phase segments back to the upstream three-phase node. The Joint IOUs recognize that stakeholders raised during the workshop two key challenges with the IOUs' current map functionality. First, in some cases, users may find a gap in the contiguous line segments due to the removal of equipment. These gaps can create uncertainty as to which path to trace. Second, CALSSA indicated that in some cases where multiple circuits follow the same path, the user may not be able to clearly identify which circuit to trace back to. While the Joint IOUs understand these conditions, the Joint IOUs believe that the application of this functionality is limited. Despite the limited application, to further assist developers, the Joint IOUs have added the circuit ID and/or circuit name of the upstream three-phase line segment to the pop-up windows for single-phase line segments. The Joint IOUs will also add documentation to their user guides to explain how to trace single-phase line segments back to their upstream three-phase line segment. Implementation of additional functionality beyond what is currently available requires a formal Commission decision and an authorized pathway to recover costs.

2. Updates to User Guides

Currently, the Joint IOUs have user guides that are posted and available on their respective data portal sites. As significant functionality changes occur to the data portal, the Joint IOUs agree to update their user guides. The update can also include the date and revision number of the update. The user guides will continue to be posted on each IOU's respective data portal site.

3. Common Terminology

The IOUs are currently assessing the level of difficulty to implement a single name change on the back-end and offer that up as a point of reference. In some cases, the names may be hard coded in backend systems, presenting significant challenges to change. At a minimum, each IOU will include in their ICA user guide a mapping table of the different IOU terminology and how the terms relate to one another.

4. Application Programming Interface (API)

All three IOUs' external portals currently offer API functionality. Per the September 9, 2019 workshop, the Joint IOUs understand that IREC agreed to further investigate the current functionality and inform stakeholders of their findings. Should the Commission deem inclusion of additional functionality beyond what has previously been directed and is currently available, the Commission should provide such direction through a formal Commission decision.

5. Query

Stakeholders have requested that SDG&E and PG&E provide query functionality like SCE's. SDG&E and PG&E understand how this functionality could provide an added benefit to some stakeholders. However, the benefit to implementing the change should be weighed against the cost, risks, and level setting against the value and cost burden on ratepayers. Implementing such a change would require additional development for a potentially limited use case. Furthermore, it is important

that implementing new functionality not negatively impact the performance of existing functionality. The ICA datasets are large and multi-parameter queries on large data sets can impact performance. The Joint IOUs are generally concerned about performance degradation as enhancements are made.

PG&E and SCE have recently made available a file geodatabase ("GDB") that can be downloaded and opened in free GIS software. SDG&E can also make a similar file geodatabase available. The GDB can be loaded in free software and query functionality like SCE's online attributes table can be performed. The Joint IOUs encourage stakeholders to investigate whether their needs can be addressed using an GDB. The Joint IOUs will continue to update these files on a monthly basis and, given that the file geodatabase is loaded on a local computer, the approach does not impact the performance of the ICA maps. Should the Commission deem enhanced online query functionality similar to SCE's online attributes table to be required of all three IOUs, the Commission should provide that directive through a formal Commission decision.

6. Review of IREC Attachment 1: ICA Map Issues

The Joint IOUs provide a response to the table in Attachment 1 of IREC's opening comments[6].

No.	Issue Description (from IREC)	IOU Response(s)
1	PG&E's ICA results are not accurate or reliable. They show dramatically less capacity than logically should exist overall, and in specific locations, for both load and generation. In addition, IREC found some circuits where the ICA values for the different constraints do not appear to be logical. For example, in one location the thermal ICA seems to vary dramatically by hours in the day, not corresponding with hours of daylight necessarily.	Addressed in Appendix 3.
2	Significant portions of PG&E's service territory lack ICA results because in "situations where an ICA solution was	As presented to stakeholders on April 25, 2019, circuits with incomplete solution sets are mapped on the ICA results layer in a

[6] IREC Comments, Attachment 1, ICA Map Issues.

	unable to converge for enough hours, the results will not be displayed on the map. In these cases, the feeder level lines will show, but the ICA level lines will not show." Response of PG&E to Concerns Raised by Stakeholder Following the January 28, 2019 Workshop.	different color. PG&E's ICA development efforts have allowed for the prioritization of these circuits beginning in September and anticipates publishing approximately 200 of these circuits at the end of the month.
3	The IOUs should perform data validation and quality assurance/quality control (QA/QC) for ICA load, because those values show a severely constrained system and their accuracy is questionable.	Addressed by these Joint IOU comments. *See* Section A above.
4	SDG&E's map does not display the location of substations. The exact location of a substation is important information for project developers. SDG&E's substation display is confusing and not informative.	SDG&E's data portal displays the area that the substation serves. When a user clicks on the substation area, a pop-up window appears and displays the requirements set forth by D.17-09-026. The following substation information is displayed: Substation Name Existing Generation (MW) Queued Generation (MW) Total Generation (MW) Projected Load (MW) Penetration Level (MW) Load Profile
5	SDG&E violates the ALJ's ruling on data redaction practices by redacting information that the Commission ordered be available. The only data that an IOU may redact is the load profile (and the ICA Operational Flexibly Criteria Violation which often is equivalent to load data) when a substation, circuit or line segment violates the 15/15 rule.	SDG&E's redaction of data that conforms to the 15/15 Rule is authorized in Administrative Law Judge's Ruling Addressing Pacific Gas and Electric Company, Southern California Edison Company, And San Diego Gas & Electric Company's Claims for Confidential Treatment and Redaction Of Distribution System Planning Data Ordered By Decisions 17-09-026 And 18-02-004 (Dated July 24, 2018). If a circuit or substation fails the 15/15 rule, it will be redacted from the data portal map. Data can be made available as requested.
6	SDG&E does not identify on its map where it redacts or aggregates data. Leaving a map	As stated in Item 5 above, SDG&E's redaction of data that conforms to the 15/15

	blank or a data field empty does not inform a user that data was knowingly redacted. A user might think that the data does not exist, or that there was a technical error in accessing the data.	Rule is authorized in *Administrative Law Judge's Ruling Addressing Pacific Gas and Electric Company, Southern California Edison Company, And San Diego Gas & Electric Company's Claims for Confidential Treatment and Redaction Of Distribution System Planning Data Ordered By Decisions 17-09-026 And 18-02-004* (Dated July 24, 2018).
7	It is not possible to determine the three-phase line segment that a single-phase line connects to.	Addressed by these Joint IOU comments. *See* Section C.1. above.
8	SDG&E and PG&E's maps do not allow users to search for and identify line segments based on available hosting capacity or other criteria.	Addressed by these Joint IOU comments. *See* Section C.5. above.
9	PG&E redacts all ICA Operational Flexibly Criteria Violation values on every circuit.	Beginning in August 2019, PG&E incorporated an updated redaction analysis into its ICA workflow, reducing the amount of redacted data. This redaction analysis must be performed at the same time as the reverse power flow analysis.
10	The IOUs should perform data validation and quality QA/QC. The need for and importance of ensuring the accuracy and consistency of the ICA results has been heightened dramatically since the working group filed the LTRR because the Rule 21 proceeding has moved forward with plans to use the ICA results in the screening process.	Addressed by these Joint IOU comments and appendices. *See* Section A above.
11	PG&E and SDG&E do not provide API access to Distribution Resources Plan portal data.	Addressed by these Joint IOU comments. *See* Section C.4. above.
12	It would be helpful to have the IOUs display existing generation, queued generation, total generation, and relevant notes in the substation pop-up box.	SCE and SDG&E currently provide this information. PG&E has noted this request and will consider it in future iterations of the ICA maps, appropriately accounting for all other priorities.

13	PG&E and SDG&E's ICA maps do not include the location of transmission lines. It is useful to have the location of transmission lines displayed on the map because it provides important context regarding costs and opportunities for certain projects.	PG&E's preference is to not publish transmission line data for the general public. However, PG&E currently meets the PVRAM transmission line mapping requirement on the PVRAM maps. Unless the Commission directs otherwise, if the PVRAM maps are retired, PG&E plans on mapping transmission lines on the ICA map. SDG&E's preference is to not publish transmission line data. Transmission lines are not relevant to the ICA maps and SDG&E does not see the relevance on how transmission lines provide context to costs and opportunities to DER's interconnecting on the distribution system.
14	User guides are not required to be updated when the functionality of a map changes. Keeping user guides up to date ensures that they are relevant and helpful to users.	Addressed by these Joint IOU comments. See Section C.2. above.
15	SDG&E requires manual approval of every user account and then revokes a user's access after non-use for sixty days. Once access is revoked, a user must request that access be restored, and then an SDG&E employee must manually allow access.	SDG&E is adhering to its registration process created as part of users requesting access to its data portal and as authorized within the registration process within Rulemaking 14-08-013.
16	The IOUs should work together to ensure consistency in terminology and functionality of the maps and downloadable data. For example, the IOUs use different names for the ICA Operational Flexibly Criteria Violation value.	Addressed by these Joint IOU comments. See Section C.3. above.
17	The IOUs do not consistently aggregate load profiles.	To protect customer confidentiality, SCE aggregates load profiles for circuits that fail the 15/15 Rule at the circuit level. PG&E redacts instead of aggregates load profiles as the aggregate load profiles are not relevant to each specific circuit and each circuit's ICA results. PG&E has discussed this with stakeholders and has not heard any significant concerns.

18	Satellite image layers assist developers with site assessment, and therefore make the map more useful for interconnection customers.	SDG&E does not see the benefit to SDG&E ratepayers of consistency between the IOUs of ICA mapping, especially when the benefits would not be commensurate with the costs of achieving it. Implementation of additional functionality beyond what is currently required and available is dependent upon a Commission decision.

III.

CONCLUSION

The Joint IOUs appreciate the opportunity to provide these reply comments.

Respectfully submitted,

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Dated: September 30, 2019

Appendix 1

SCE'S Data Validation Plan

Appendix 1: SCE's Data Validation Plan

This appendix is sponsored solely by SCE. PG&E and SDG&E do not join in this appendix.

As discussed during the September 9 workshop, SCE's quality control and results validation processes consist of automated and manual steps to ensure the accuracy of both the data inputs to the ICA process, and the ICA results. These steps are taken on a continuous basis and are initiated by a set of triggers.

In the workshop, SCE discussed the potential of benchmarking the ICA results with the results of interconnection studies performed as part of the existing interconnection process to understand the level of consistency. In addition, SCE will review the assumptions and methodology that are being applied to generation ICA to ensure they are consistent with approved methodology and make corrections as necessary.

In opening comments, CALSSA, Cal Advocates, and Clean Coalition recommended validation of the ICA results through evaluation by an independent third party.[7] This approach was also discussed on the workshops for the long-term refinements to ICA, specifically stakeholders agreed to validate the ICA methodology by leveraging an IEEE standard circuit model. However, a third-party study was not completed. While SCE views that this third-party validation to have some merit, SCE recommends prioritizing identifying and correcting the root causes of inaccuracy in the ICA results. SCE thoroughly supports the application of ICA results to the interconnection use case. Through detailed investigation of the end-to-end business process, SCE expects to attain a level of confidence in the ICA results suitable to support the interconnection use case.

[7] CALSSA Comments, at p. 7; Clean Coalition Comments, at p. 7; Cal Advocates Comments, at p. 10.

Appendix 2

SDG&E's Data Validation Plan

Appendix 2: SDG&E's Data Validation Plan

This appendix is sponsored solely by SDG&E. SCE and PG&E do not join in this appendix.

SDG&E believes the appropriate way ICA data should be evaluated was vetted out within issue 8b and 8c of Rule 21 Working Group 2. SDG&E believes that it simply is not practical to verify each and every one of the over 90 million ICA values on SDG&E's data portal. For this reason, as stated within 8b of the report, SDG&E proposes to validate the ICA value at the DER point of interconnection during the initial review process. SDG&E awaits the ruling on the final Rule 21 Working Group #2 report. Furthermore, SDG&E has a QA/QC process to flag inconsistencies identified at various stages throughout the ICA process. The stages include the model building process, the ICA results process and the mapping process. The QA/QC automated flags for each of these processes is shown in the below tables.

Model Building Process

Flag/Script	Description
Model did not converge	For various reasons, a model may not converge, i.e. missing equipment, missing conductors, no profile, etc.
Missing settings for equipment i.e. regulators, relays	During the automation of the model building process, settings from different equipment is pulled into the models from different source tables. If the source table is missing a value or is not within the excepted settings range, an error gets triggered for the engineer to review and resolve.
Flat profiles or no profile for a feeder	An automated flag is triggered when there is no profile or a flat profile for a given feeder.
Large queued generation on single phase line section	During the addition of queued generation to the circuit model, a flag is triggered that captures large generation on a single-phase line. When the flag is triggered, an engineer reviews the validity of the location of the generator.
Customer class with missing load profile curve	An automated flag is triggered when a load profile is missing for a residential, industrial or commercial class.

ICA Process

Flag/Script	Description
All of the 576 ICA results are flat/zero	This flag captures when the ICA results are all zero or all results are similar.
Results do not include all of the 576 data points	This flag captures when the ICA results do not include all 576 data points because the model stops at a particular point in the process.
Cannot find a tie switch on a circuit model	This flag captures GIS discrepancies in switch types or the model cannot locate a tie switch.
Protection fault data error	This flag captures when there is missing protection data.
Zero values for similar hours for all circuits at a given substation.	This flag identifies when all the ICA results are the same or are zero.

Mapping Process

Flag/Script	Description
Mismatches on number of line sections	This flag captures when the amount of line sections containing ICA results does not equal the amount of line sections on the GIS circuit map.
Comparison of percent change of ICA ranges i.e. Percentage of ICA results that have a zero value.	This flag will trigger an engineering review of a comparison of a large percentage change of ICA results.

Appendix 3

PG&E's Quality Control Process

Appendix 3: PG&E's Quality Control Process

This appendix is sponsored solely by PG&E. SCE and SDG&E do not join in this appendix.

PG&E is currently engaged in a year-long development effort to operationalize ICA and better incorporate quality control into the ICA process. As mentioned in PG&E's opening comments, the primary method PG&E has chosen to manage quality control is through GridUnity's Network Model Management (NMM). The NMM software uses a combination of automated engineering rules and manage by exception routines that offer PG&E the ability to address data issues before systematically initiating ICA for each circuit. There are multiple processing routines within NMM; however, they can be categorized into the following four.

- Model Intake ingests PG&E's distribution model and automatically performs routine model-handling updates to prepare a circuit specifically for ICA.
- Sanity Check performs situation-based model corrections, automating existing manual processes, and flagging to engineers any corrections that cannot be addressed through the processing.
- Peak Load Allocation checks for modeling errors identified after a peak load flow is performed.
- Hourly Load Allocation performs time- and power flow-dependent steps for all 576 hours.

NMM will enable a more streamlined approach to identifying potential false positives and potential false negatives in ICA results, validating results as engineering-ready without being unnecessarily restrictive.

I. INITIAL QUALITY CONTROL PROCESS DURING DEVELOPMENT

Figure 1 shows a flow chart of the initial quality control process used during this development effort. For the results PG&E published in December 2018, it took over thirty years of computer processing time to perform the analysis on all 576 hours. To make up for this constraint in the development effort, ICA workflows can be performed for a smaller set of hours, referred to as "critical hours." Developing around a smaller set of hours allows for a shorter development cycle where data corrections, new rules, and new processes can be quickly tested by running only a fraction of the 576 hours that are ultimately required for publication.

After the critical hours workflow is performed, results are manually checked for false negatives. If the manual check does not pass, the situation is reviewed to determine if it is unique to the circuit or if a new rule or data correction can be applied globally. If a change is implemented, the workflow is repeated for the circuit. If the manual check for false negatives passes, a workflow is performed on all 576 hours, after which the results are analyzed for false positives to determine if they are included in the monthly update.

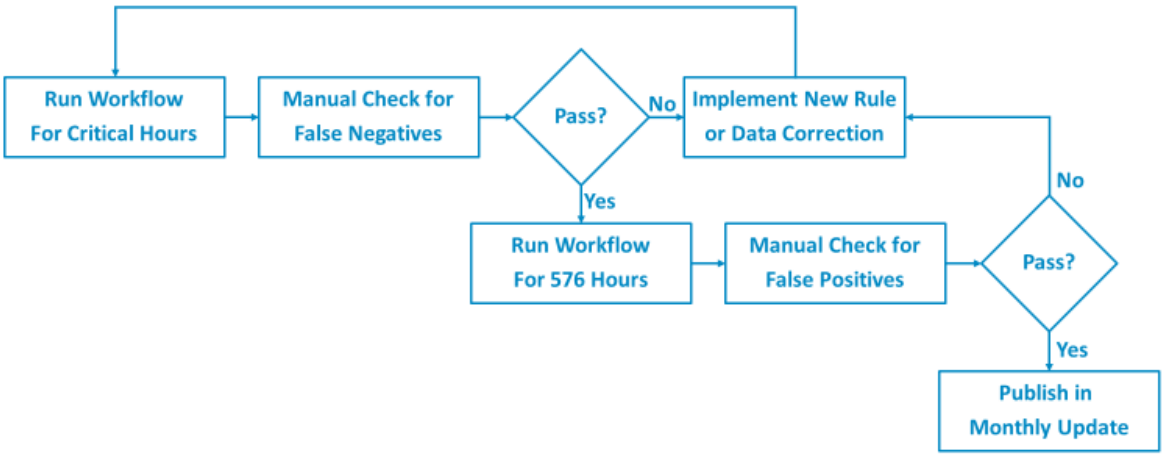

Figure 1 - Initial Quality Control Process During Development

As of the August publication, this development and quality control effort has included the publication of ICA results for 64 feeders.[8] While the results of these feeders are undergoing quality control, the 64 feeders have gone through a more thorough validation than the feeder results published in December 2018.

The following figures compare the published results of the 64 feeders from December 2018 (prior to any quality control[9]) and August 2019 (after quality control). The figures show an overall increase in the integration capacity values. Potential reasons for the increase are further explained following the figures.

[8] A large amount of foundational development work was performed to get to this number and future circuits will be studied at a faster rate.

[9] Not inclusive of incomplete solution sets not published in December 2018.

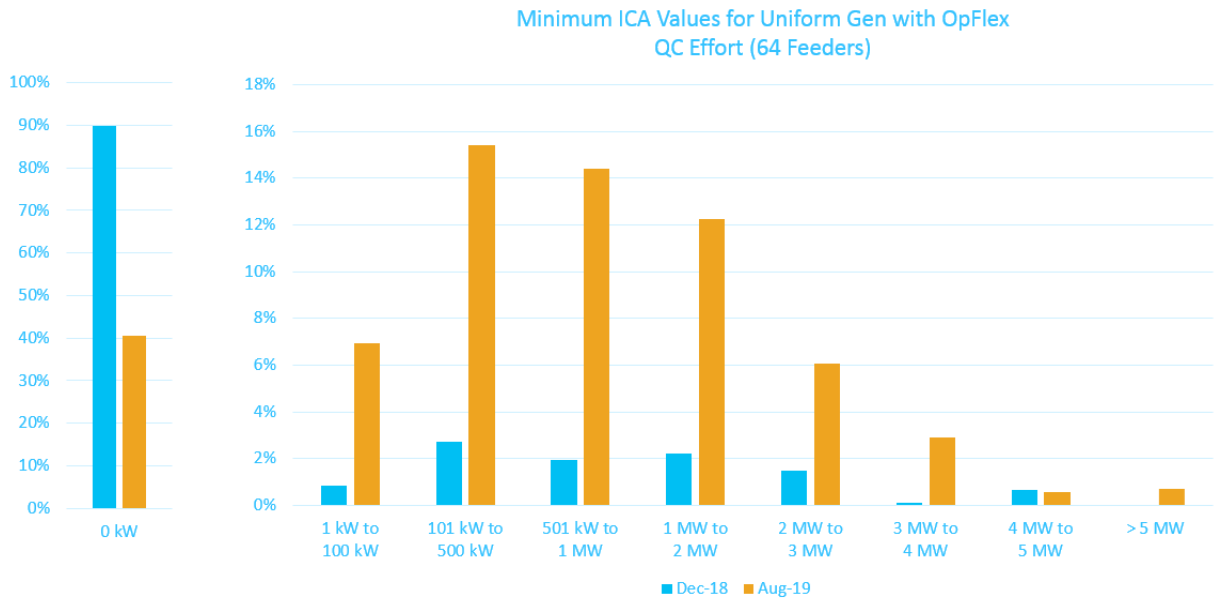

Figure 2 - Minimum ICA Values for Uniform Gen with OpFlex

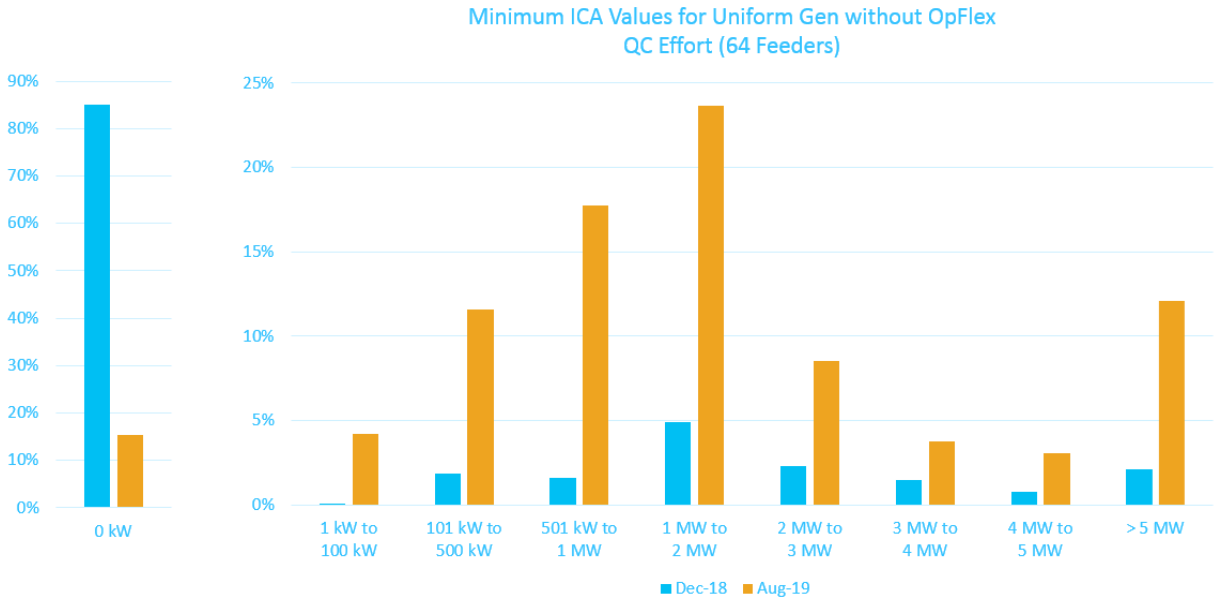

Figure 3 – Minimum ICA Values for Uniform Gen without OpFlex

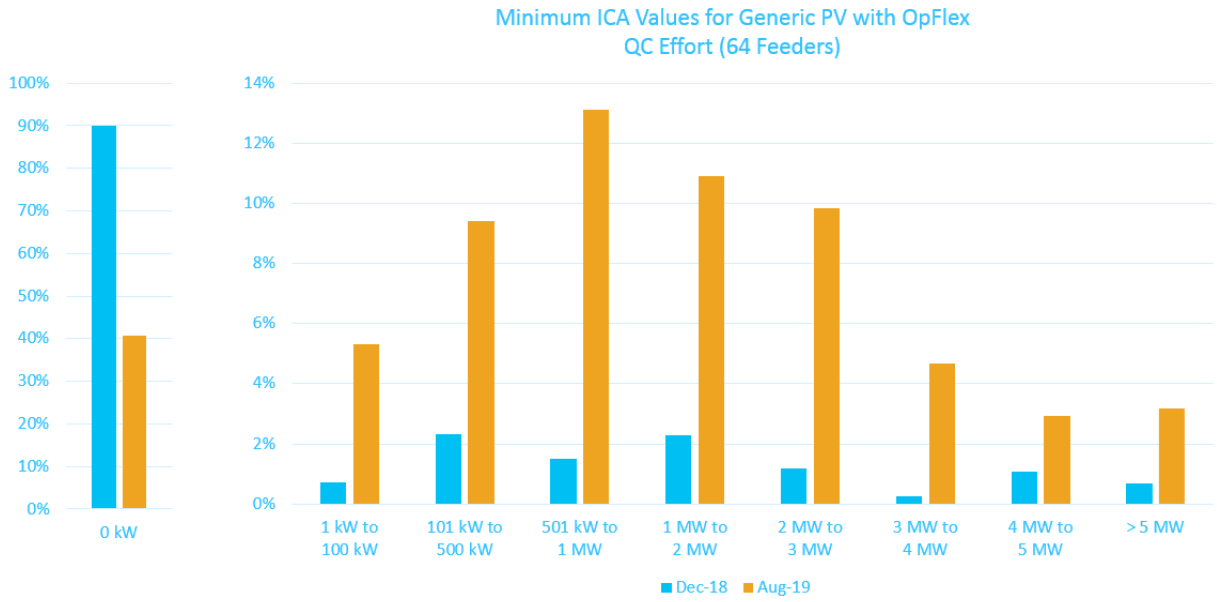

Figure 4 – Minimum ICA Values for Generic PV with OpFlex

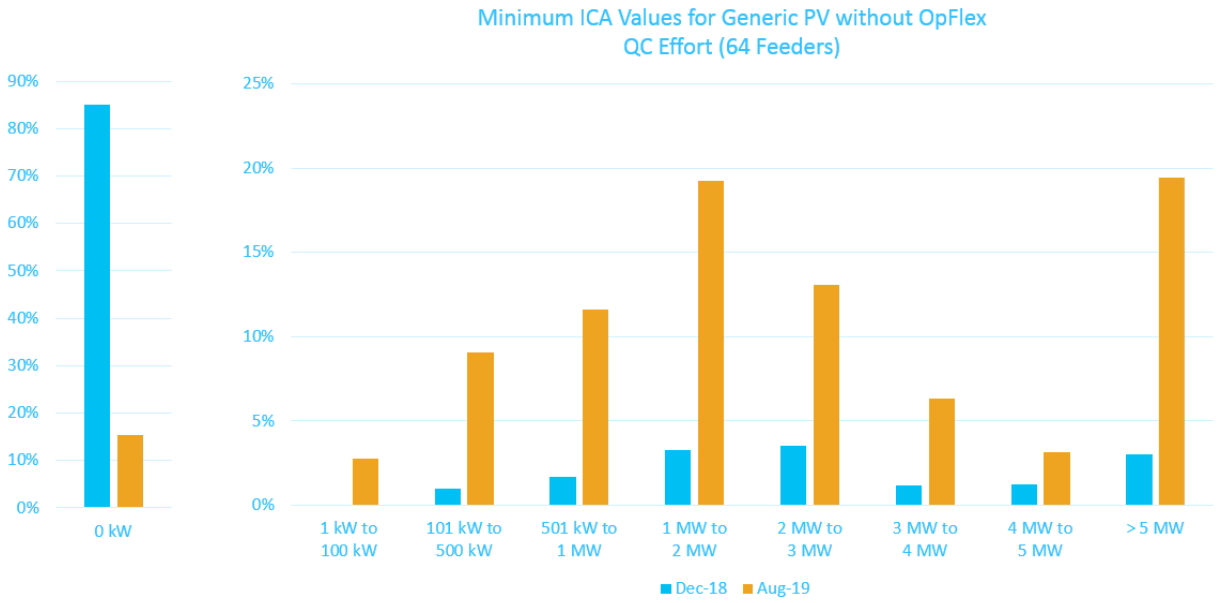

Figure 5 - Minimum ICA Values for Generic PV without OpFlex

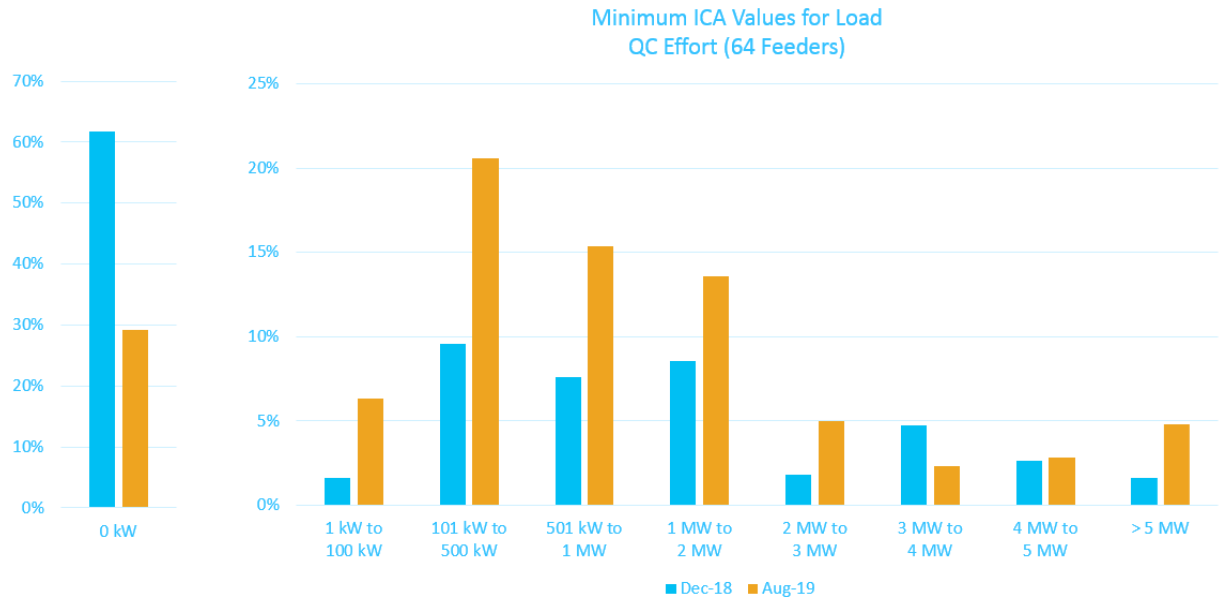

Figure 6 - Minimum ICA Values for Load

II. EXAMPLES OF QUALITY CONTROL IMPROVEMENTS

The previous figures demonstrate an increase in minimum (most-limiting-hour) ICA values. Potential reasons for the increase include: (1) using GridUnity's Network Model Management (NMM) for PG&E's ICA, (2) enhancements to CYME's ICA algorithm, and (3) updates where possible to PG&E's Electric Distribution GIS (EDGIS).

A. GridUnity's Network Model Management (NMM)

Examples of how NMM has been used include but are not limited to:

- Equipment Modification – PG&E has identified system-wide rules for NMM to execute to prepare a model for the specific use case of ICA. For example, modifying substation equipment to account for default equipment types limiting ICA.
- Settings Modification – Modifying capacitor settings in summer and winter months. Only one summer setting was used previously for ICA.
- Failure and Warning Triggers – Establishing failure and warning triggers before ICA is executed for situations such as:

- Default Equipment
- Loading Violations
- Voltage Violations

- Enhanced Convergence Strategies – PG&E has developed different levels of load flow settings to implement when a solution set is not complete. The first iteration of this strategy involves modifying the way regulators and capacitors are operated when a solution does not complete.
- Different Types of ICA Runs – NMM allows PG&E to run ICA for only a select number of hours (single hours and critical hours) without having to perform a full 576-hour run. This has allowed PG&E to test and perform quality control more quickly.

B. CYME's ICA Algorithm

PG&E has been working with CYME to identify enhancements to the ICA algorithm, some of which have been deployed in the CYME version currently used by NMM. These enhancements include:

- Pre-Existing Loading Conditions (Critical Path Thermal Loading) - One of the more exciting updates is the inclusion of a new ICA setting related to thermal loading. The new setting allows for the thermal loading review of only the critical path back to the source for loading violations. Previously, adding load or generation on one node might cause an unrelated device to go from 101% of its planned loading limit to 101.001% of its planned loading limit.[10] Without the new ICA setting, an unrelated device's loading changing from 101% to 101.001% resulted in an ICA thermal limit of 0 kW. Now CYME's ICA algorithm has the option to only review the critical path back to the source for thermal loading.
- Pre-Existing Voltage and Loading Conditions – CYME has implemented some improvements to the handling of pre-existing voltage and loading conditions.
- Limiters – Improved identification of ICA limiters, allowing for PG&E to perform a more thorough quality control.

[10] The small change results from the load flow solution converging on a slightly different voltage that in turn results in a slightly different loading at each device.

- Convergence – Improved handling of circuits that have convergence challenges.
- Capacitor Convergence – In some cases, load flow was converging too quickly and capacitors were not reaching their steady-state position. This has been updated in the latest version of CYME.

C. EDGIS Updates

As a part of the QC effort, PG&E has been looking to identify system-level updates to PG&E's Electric Distribution GIS (EDGIS). These updates include but are not limited to:

- Voltage Boosters – Updating the status of fixed voltage boosters, improving the quality of ICA voltage limits.
- Elbows – Updating the rating on some elbows, improving the quality of ICA thermal limits.
- Recloser Line Sections – Updating the rating of some recloser line sections, improving the quality of ICA thermal limits.
- Capacitor and Voltage Regulator Settings – Updating the settings on some capacitors and voltage regulators, as well as updating the conversion process from EDGIS to CYME.

III. FUTURE QUALITY CONTROL PROCESS

PG&E will continue to perform quality control on ICA results and anticipates future opportunities to leverage GridUnity's NMM, enhancements to CYME's ICA algorithms, and updates to PG&E's EDGIS. One way in which NMM will be used to perform quality control going forward is shown in Figure 7. Automated checks will first be performed using pre-ICA stages, qualifying whether a circuit needs to be reviewed manually before going into ICA. Automated checks will also be performed on the ICA results after they are processed to determine if the results need a manual review. New rules and data corrections will be implemented as they are identified.

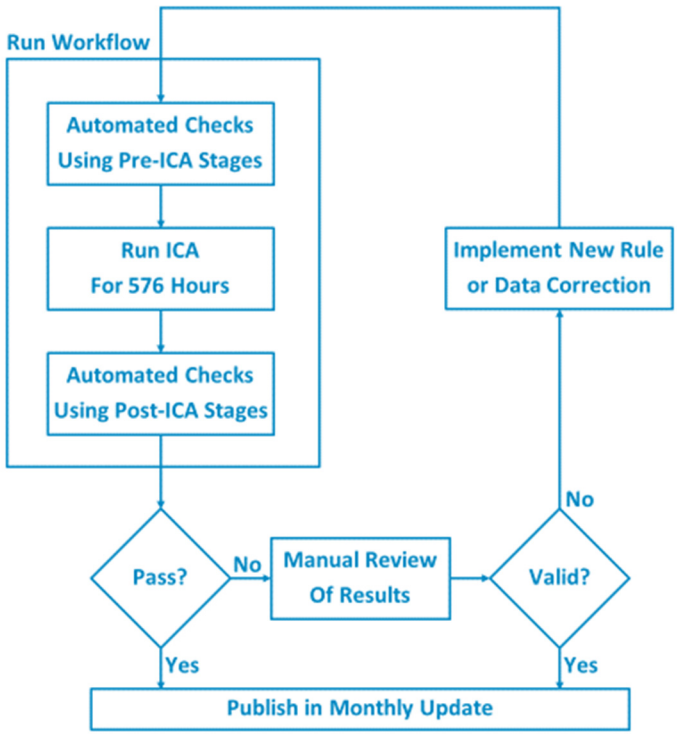

Figure 7 - Future Quality Control Process

IV. TIMELINE GOING FORWARD

Figure 8 provides a high-level timeline of ICA efforts performed year-to-date and the plan going forward. PG&E estimates that 200 circuits will be published in September and 500 circuits in October. In September and October, PG&E is prioritizing the analysis of circuits with incomplete solutions that were not included in the December 2018 publication. A system-wide refresh of results is estimated to begin in November and be 80% complete by end-of-year. PG&E estimated completion of the system-wide refresh in Q1 2020.

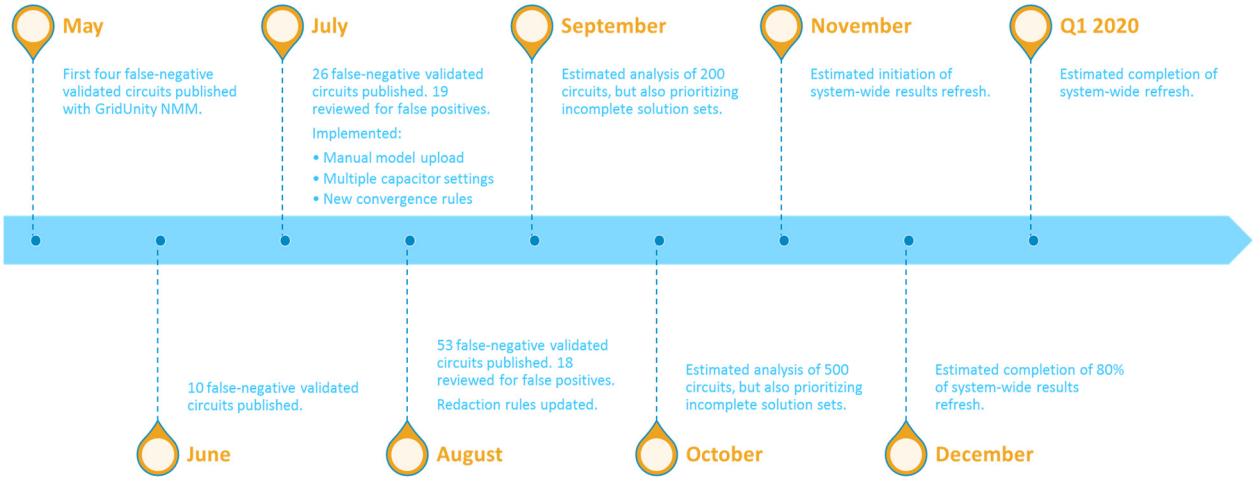

Figure 8 - Timeline Going Forward